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2005+403—A QSO NEAR THE GALACTIC PLANE

A. Boksenberg, S. A. Briggs, R. F. Carswell,

University College, London

M. Schmidt

Hale Observatories, Carnegie Institution of Washington,
California Institute of Technology

and D. Walsh

University of Manchester, Nuffield Radio Astronomy Laboratories,
Jodrell Bank

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SUMMARY

The optical object associated with the unusual variable radio source 2005+403 at galactic latitude 4°·3 is shown to be a QSO with an emission redshift of 1·736. An estimate of reddening suggests that the extinction in B is about $3^m·5$.

The radio source 2005+403 was found near the very intense source Cyg A by Peckham & Palmer (1972). Further investigation by Adgie, Palmer & Penston (1975) showed that the radio source is variable on a timescale of a few months, and that the accurate radio position is coincident with a $19^m·5$ blue stellar object. This QSO or BL Lac candidate was also found to vary, brightening to about $18^m·5$ in 1973 November.

We report here on spectroscopic observations of this object made using the UCL Image Photon Counting System (Boksenberg & Burgess 1973) on the Oke-Gunn Cassegrain Spectrograph mounted on the Hale Observatories 5-m telescope during 1974 October. The spectrum covers the region 3300–6500 Å, and observations of object plus sky and of sky alone were made through two widely-separated apertures of approximately 2″ by 2″. The observation period of one hour was divided into two equal parts, and the object was observed first in one aperture then the other. In this way differences in spectrograph and detector system between the two apertures cancel, at least to first order. It was found in both sky and object channels that emission lines due to an intervening galactic H II region were present, and so there is increased noise in the subtracted signal, especially in the region of rest Hα, Hβ and [O II] 3727. The same is true, of course, in the region of the night sky lines.

Fig. 1 shows a sky-subtracted renormalized spectrum of 2005+403. As can be seen, there are some residuals from imperfectly subtracted night sky and nebular lines. These affected more channels than is usual with the instrument since an electronic fault prevented the event-centring logic from operating. There are two emission lines well clear of the night sky and nebular lines, and a third

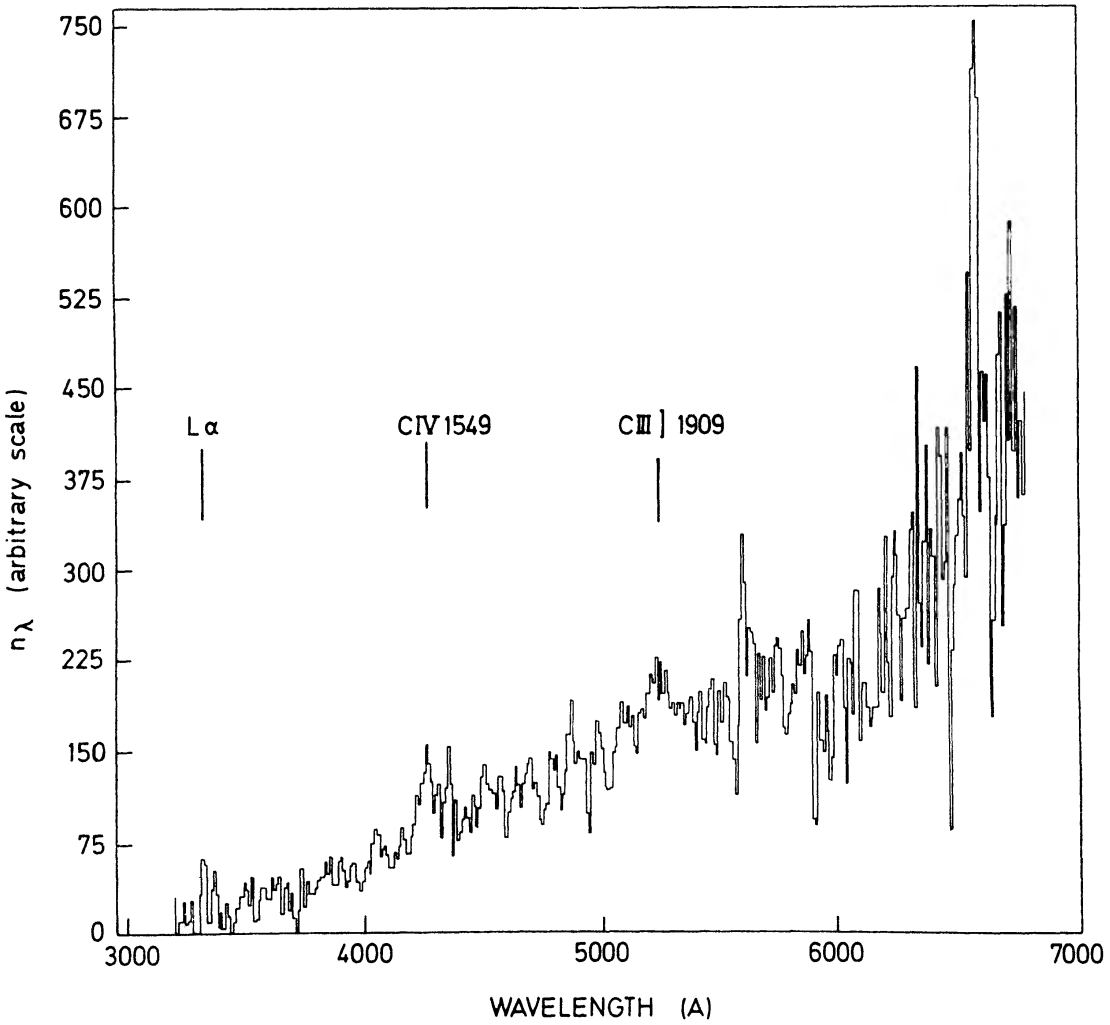

FIG. 1. *The spectrum of* 2005+403. *The identified emission lines are indicated. Some residuals are present from imperfect subtraction of night sky and lines from the intervening H* II *region.*

TABLE I

Emission lines in 2005+403

Observed wavelength Å	Character	Identification	Redshift z
3330	Sw	Lα	1·738
4243	SMw	C IV 1549	1·739
5215	Mw	C III] 1909	1·732

probable feature at 3330 Å in a region of poorer signal-to-noise ratio. The object is clearly a QSO, and the redshift, based on the line identifications given in Table I, is $z = 1{\cdot}736$. It might be argued that the two definite features could be identified with Mg II λ2798 and [Ne V] λ3426 at $z = 0{\cdot}519$, but the [Ne V] line would then be unusually broad and the probable 3330 Å feature unexplained, so we feel that the $z = 1{\cdot}736$ redshift is secure. The continuum renormalization is only approximate for two reasons. Firstly the use of a narrow aperture means that atmospheric refraction will make the amount of light passing through the slit wavelength-dependent, and secondly there were too few standard stars faint enough for

observing with the photon counting system at the low dispersion used. The first primarily affects the blue and ultraviolet calibration, and the second has added uncertainty in the same region since 2005+403 and the single object used as a standard were observed at different zenith distances. However, atmospheric effects should be small above 4500 Å. Clearly, in any case this QSO is unusually red, and would not be expected to be strongly blue on the Sky Survey.

In view of the low galactic latitude ($l = 86°{\cdot}8$, $b = 4°{\cdot}3$) it is of interest to enquire if the energy distribution observed is consistent with a usual QSO power-law continuum spectrum reddened by the amount we might expect looking through that part of the Galaxy. A very large discrepancy in the reddening between 2005+403 and the nearby Cyg A galaxy might, for example, be difficult to explain if both objects are extragalactic. However, we do not know what the intrinsic slope of the continuum is, so choose $F_\nu \propto \nu^{-1}$ as a reasonable first guess, though if it is a rapid variable it may well be steeper (Carswell *et al.* 1974). Under these circumstances we find, by comparing the unreddened with the observed flux at three points in the range 4850–6560 Å, that the wavelength-independent extinction coefficient (Osterbrock 1974) $C \simeq 1{\cdot}1$. This corresponds to a reddening $E_{B-V} \simeq 0^{m}{\cdot}8$. Hence we find good agreement with the value $C = 0{\cdot}95$ found for Cyg A itself (Osterbrock & Miller 1975). If the estimate of reddening is correct, then the extinction in B is about $3^{m}{\cdot}5$, and so 2005+403 would be 15–16^{m} were it not for galactic obscuration, which means it is one of the brighter QSOs but not exceptionally so. Clearly, an improved estimate of the obscuration could be obtained by spectrophotometry covering a larger wavelength range, which would also give a lower limit from study of the Balmer decrement of the intervening H II region, but this must await properly calibrated observations.

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